(12) UK Patent Application (19) GB (11) 2 287 966 (13) A

(43) Date of A Publication 04.10.1995

(21) Application No 9505727.9

(22) Date of Filing 21.03.1995

(30) Priority Data
(31) 9405546 (32) 21.03.1994 (33) GB
08217148 24.03.1994 US

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(51) INT CL[6]
D06P 3/87 , D03D 15/00 // D06P 3/872

(52) UK CL (Edition N)
D1K K307 K316 K420 K470 K57Y K571 K581 K62Y K63Y K64Y K68Y K687 K688 K70Y K703 K711 K764 K767 K780 K793
U1S S1215

(56) Documents Cited
GB 1059567 A US 4801303 A US 4678473 A
US 4300902 A

(58) Field of Search
UK CL (Edition N) D1K
INT CL[6] D03D 15/00 , D06P 3/82 3/87 3/872 3/874
Online : WPI,CLaims

(54) Woven fabrics with coloured effects

(57) A woven fabric is made of warp threads (11) and weft threads (12). The warp threads have a different composition from the weft threads and at least one of the warp threads or weft threads is comprised of a multifilament yarn. The fabric is coloured after it is manufactured with a dyestuff which is preferentially taken up by the warp threads, but substantially repelled by the weft threads, and a different dyestuff which is preferentially taken up by the weft threads and substantially repelled by the warp threads. The resulting fabric has shot silk effect. The warp threads may be of spun fibre yarn of natural material. The weft threads are multifilament yarns of synthetic fibres or silk, e.g. micro fibres.

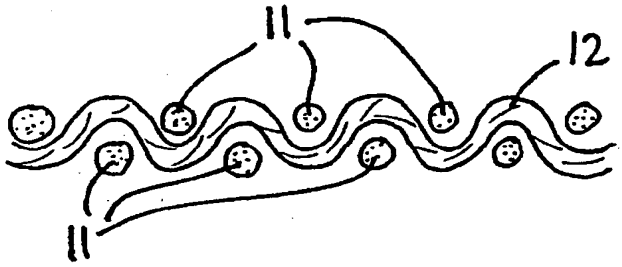

Fig. 2

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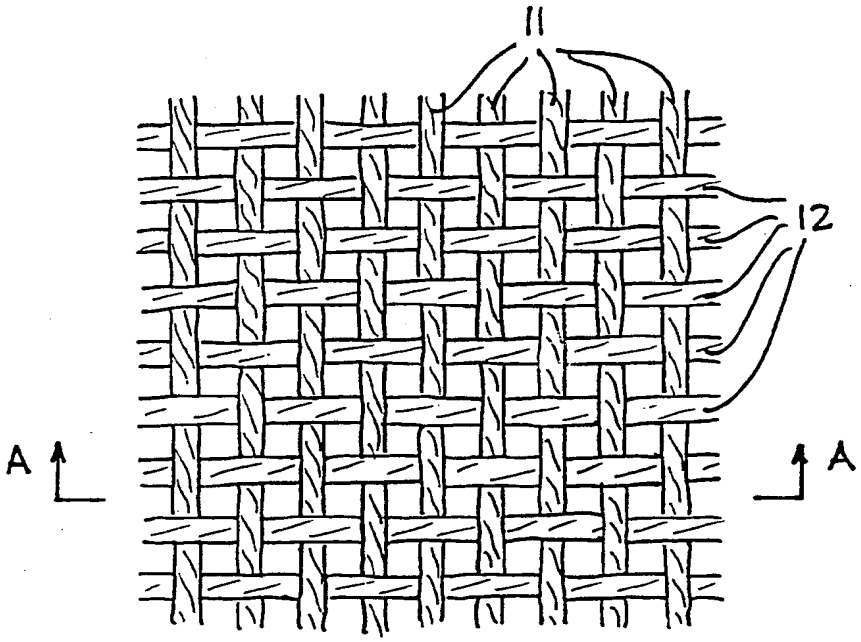

Fig. 1

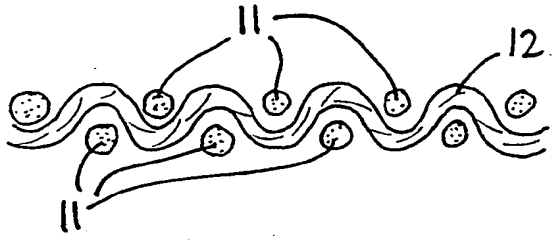

Fig. 2

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TEXTILE FABRICS

This invention relates to textile fabrics, and more particularly to processes for the manufacture of textiles, and the resulting cloth which is characterised by its colour effects, and its smooth silky surface, and handle.

The principal field of this invention is in the manufacture of wide width sheeting. This cloth is manufactured commercially in very great quantity, and finds particular utility for furnishing fabrics, bed linen and table linen.

At the present time, blended basecloth which is conventionally used for wide width sheeting is woven uniformly from a warp and weft of completely blended polyester and cotton spun yarn. The blended yarn is treated, before or after weaving, with optical whites, to give the highest possible uniformity and enhancement of solid colour when dyed.

Cloth woven in this manner can be dyed by the piece, in a range of plain solid colours, or can be pigment printed, for which it is equally suited. It is kept cheaply in stock ready for colour treatment in either or both of the above ways. After dyeing or printing, the cloth can be finished by a simple heat treatment. Massive quantities of 50/50 blend polyester/cotton are woven cheaply and used routinely and uniformly by mills throughout the United States of America.

This invention has, as one object, to produce a shot silk look and similar effects in blended sheeting and other textiles with a design scope that extends beyond the colour finishes that can be and are obtained with presently known techniques.

The effect of shot silk is well known. This is an iridescent play of colours produced by weaving silk with differently coloured warp and weft yarns. This invention addresses the problem of introducing similar complex effects into bulk woven sheeting. The apparently straightforward approach of dyeing the blended polyester/cotton yarns differently for the warp and weft and then weaving the cloth as required is prohibitive for economic reasons. The blended wide width sheeting industry is built on the economic necessity for long production runs to meet its wide distribution. Each mill makes a financial investment in the commercially accepted yarns, of which about 65% are blended polyester/cotton yarns, and about 35% are 100% cotton yarns, which are woven in the universally accepted basecloths at their accepted price points. This commodity cloth is held in stock as a general resource for either dyeing or printing, leaving the economic flexibility of being able to meet the end users' specific needs/demands. Additionally, the traditional method by weaving to produce the shot silk effect would require mills to keep huge stocks of different pre-dyed yarns to meet the different orders.

It is proposed in accordance with the present invention to provide a manufacturing and colouring process which is suitable for wide sheeting, which allows the cloth to be woven economically and consistently in long runs and in bulk, which does not require stocks of different coloured pre-dyed yarns, and yet which permits flexible and versatile production of colour play effects in the cloth.

The present invention concerns aspects of the processes and textiles described below. The scope of the invention extends to all novel aspects thereof whether individually or in combination with other features as described herein.

Expressed in general terms, the invention provides a fabric for colouring, by dyeing or printing, woven from at least two component yarns. These yarns are not dyed or printed until after the cloth has been woven, so that a single consistent greycloth can be woven in a long run on a loom, and held in stock until a later stage when the final question of colour need only be addressed before the cloth is finished and sold. This is achieved by using a plurality of dyestuffs which are separately compatible with different fibre types of the yarns in the weave.

A more particular process for the manufacture of textiles in accordance with the invention comprises the steps of:

providing a first yarn and a second yarn, of which at least one is a multifilament yarn, and the other is optionally a spun fibre yarn, in which the first yarn is of a different composition to the second yarn;

weaving a fabric of warp and weft threads from the first and second yarns so that one yarn provides the warp threads and the other yarn provides the weft threads; and

colouring the woven fabric by a process which is characterised by the application of at least two different dyestuffs selected with regard to the compositions of the warp and weft yarns so that at least one such dyestuff is preferentially taken up by the warp threads and at least one such dyestuff is preferentially taken up by the weft threads.

The warp and weft threads become differently coloured and the woven fabric exhibits an iridescent play of colours to the eye, or an iridescent bloom, depending on the particular selection of colours.

When one of the yarns is a spun fibre yarn, it is usually more practicable to use the spun fibre yarn as the warp.

The invention includes a woven fabric comprising different warp thread and weft thread compositions, the respective warp threads and weft threads being differently coloured after weaving.

The play of colours produced by the dyed or printed fabric of the invention is a shot effect, that is to say a colour effect which is clearly perceptible in a fabric with a warp of one colour and a weft of a contrasting colour. Transient iridescent shimmer of the kind associated with shot silk is promoted by the use of the multifilament thread.

The spun yarn fibres, as used herein, are of relatively short lengths, such as about ½ inch (13mm) to about 3 inches (76mm). Cotton fibres in particular may be shorter. In this sense, most natural fibres are short, including vegetable fibres such as cotton and flax, and animal fibres such as wool and hair. The extruded filaments of silk are exceptional. Filaments, as used herein and in contrast to spun fibres, are sufficiently long that they can be considered for practical purposes to be continuous. Most so-called man made fibres are manufactured as continuous filaments. These include polyester, polyamide, polyacrylic, polypropylene and regenerated cellulose. Short fibres for spun yarns can be made from filaments by chopping or by other processes. The invention encompasses a fabric and a process for making a fabric in which one of the yarns is a multifilament yarn made from one of the above filaments and the other yarn is a spun fibre yarn made from fibres of a different composition.

The fibre compositions for the spun yarn are preferably natural or modified natural fibres, including cotton, linen, flax, and wool, and include regenerated cellulose (rayon).

Natural fibres, especially cotton, are preferably fine. A suitable measure is an English cotton count of between 6s and 70s Ne_c (between 10s and 120s Nm), and most preferably between 30s and 50s Ne_c (between 50s and 85s Nm).

The continuous multifilament yarn will frequently comprise a synthetic material characterised by a different dyestuff response to the warp fibre. Microfibres are preferred for handle, these being made up of fine filaments with a linear density of 1 decitex or less, ie a fineness below one denier, in round figures. Filaments may be surface treated or textured, to improve their properties, as is known in principle in the textile art.

The methods of weaving the fabric are essentially conventional. For example, the fabric may be woven on rapier, air jet, water jet, terry or conventional shuttle looms, with or without dobby or jacquard capabilities. Weaving is intended also to include those knitting techniques that use both warp and weft threads, ie have different threads extending crosswise to one another. Combination warp and weft knitted fabrics, such as warp knitted fabrics with weft insertion, meet this requirement. Warp knitted fabrics may be produced on single or multi-bar knitting machines.

Generally, a square weave, in combination with a substantially even density of the warp and weft threads, is the preferred construction. Such fabrics have approximately equal numbers of ends (warp threads) per inch and picks (weft threads) per inch, or other unit length, and if the yarns are of similar bulk an even cloth will result. A distribution of the two yarns deviating $\pm$ 10% from a 50:50 ratio of warp threads to weft threads, ie up to 45:55, is most preferred, and a 40:60 split or wider differential may be acceptable. This may lead to as much as a 70:30 ratio in terms of total fibre composition calculated on a weight for weight basis.

Any weave (or knit) that gives the desired visual effect can be used. Typical ground weaves are a 1 x 1 plain weave or a 2 x 2

twill weave, which will both show similar amounts of warp and weft yarn, provided they are of a similar thickness. The cloth may be patterned at intervals by the use of a jacquard or dobby to introduce variations from this ground.

Colouring includes both dyeing and printing. Dyestuffs may be applied simultaneously or sequentially according to the compatibility of the conditions needed for each chosen dyestuff. Generally, any colouring processes that are suited to the respective yarn/dyestuff combinations can be used. The invention requires separate dyestuffs to be used for each fibre and filament type, so that the dyestuff taken up predominantly by the warp yarn is different from that taken up predominantly by the weft yarn. It may be necessary to strip off colour from the 'wrong' yarn after any dyeing stage, but with careful selection of dyestuffs and yarns there should be insufficient cross colouration to interfere with the desired contrasting colouration and resultant shot effect.

Suitable dyestuff types for dyeing and printing include pigment, vat, reactive, disperse, acid, sulphur, azoic, premetallised, modified basic dyes, and combinations thereof. Those skilled in the art will recognise which dyestuff types are suitable for the different yarns chosen in any instance.

A suitable first dyestuff for the spun yarn fibres is any dyestuff which is taken up by such fibres, but has little, if any, affinity for the multifilament yarn. Some specific first dyestuffs are exemplified as follows: reactive, vat, direct, sulfur or azoic dyes for cotton, linen, flax and regenerated cellulose; acid, acid levelling and premetallised dyes for wool.

A suitable second dyestuff for the multifilament yarn is any dyestuff which is taken up by the multifilament yard, but has little, if any, affinity for the spun yarn fibres. Some specific second dyestuffs are exemplified as follows: acid, premetallised or

disperse dyes for polyamide; basic, modified basic or disperse dyes for polyacrylic; acid, premetallised, or acid levelling dyes for silk.

In general, the invention can utilise any dyeing or printing techniques, in conjunction with any dyestuff, that are tolerated by the cloth as a whole and by the individual warp and weft yarns, provided that the result is selective contrasting colouration of the warp and weft yarns in the woven cloth by the different dyestuffs used.

Dyeing may be a continuous or batch process, or a combination. Continuous dyeing may be carried out in a single stage, or in two or more stages with intermediate fixing procedures.

Part continuous, part batch process dyeing may include the following process variations:

1 Pad, dry, bake, chemical pad, develop, wash; high temperature dyeing if required.

2 Cold pad batch, rotate, wash, dry, pad, dry, bake; high temperature dyeing if required.

3 Jig dye, develop, wash, dry; high temperature dyeing if required.

4 Beam dye, develop, wash, dry; high temperature dyeing if required.

5 Winch or jet dye, develop, wash, dry; high temperature dyeing if required.

Printing may be carried out on prepared for print ground, ie undyed bleached cloth, or by overprinting on dyed ground with the shot colour effect. Printing enables selected areas to be coloured differently. Colouring may again be simultaneous, using two or more types of dye in the same paste, or sequential.

Typical printing processes include flat screen printing, rotary screen printing, engraved roller printing, heat transfer printing and jet or spray printing.

Any required finishing process can be used, selected from the finishing techniques applied to a cloth woven from differently coloured yarns.

Chemical finishing may include the application of softeners and sewing lubricants; resin stabilisers; soil and body fat resistant chemicals; proofing agents; dye and print resisting agents; and fire retardants.

Mechanical finishes may include brushing or raising, and cropping; sanding, peaching or sueding; calendering, plain shell or engraved lines; embossing; and blanket compacting or relaxation or softening processes.

The following non-limiting examples illustrate the invention. In each case (Examples 1, 2 and 3) a plain weave is used, as illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of a small area of cloth, much enlarged, and with exaggerated thread spacing, for the sake of clarity; and

Figure 2 is a sectional view of the same piece of cloth, to the same scale, taken on the line A-A in Figure 1.

In the drawings, it can be seen that the plain weave, also known as a linen weave, consists of warp threads 11 interwoven with weft threads 12, each thread of warp and weft alternatively passing over and under the consecutive weft or warp threads respectively. Each thread shows equally, and the cloth would present the same appearance on the other side. In practice the threads would be more tightly woven together than appears from the somewhat diagrammatic drawings.

In all the Examples 1 to 6, unless otherwise specified, "parts" are parts by volume, except for solids, which are parts by weight. The proportions are correct if millilitres are used for parts by volume and grams for parts by weight.

Example 1

Woven cotton/polyester microfibre fabric - continuous single pass dyeing process

A cloth is woven on a Picanol (R.T.M.) air jet loom as follows.

Warp yarn: ring spun combed 100% cotton fibre, cotton count 1/40s Nec (68s Nm).

Weft yarn: polyester microfibre type 'Fortrel' (R.T.M.) manufactured by Wellman Inc.; 70 denier, 129 filaments (average denier of each filament: 0.5).

Construction: plain weave, 104 ± 1% ends per inch, 94 ± 2% picks per inch. Threads per inch: 198 loomstate, minimum 200 finished.

Weight composition: 66% cotton, 34% polyester.

The woven cloth is then subjected to the following processing stages, including simultaneous dyeing of both warp and weft yarns.

Process water specification:

pH	7.0 ± 0.5
Copper:	0.05 mg/l max.
Iron:	0.05 mg/l max.
Chloride ions:	300 mg/l max.
Hardness:	Temporary carbonate - permitted
	Permanent = 20 parts per 100,000 water max.
	(expressed as calcium carbonate equivalent)
	= 14° maximum average

Preferred water softening: Ion exchange (removal of all ions except heavy metals) to zero + 5 deg. variation

Preparation:

Preliminaries include singeing, one or two sides, and a 10 hour enzyme desize followed by washing off.
Thereafter:
Continuous scour and peroxide bleach
Fully mercerise at 60° Twaddell
Conclude with final bath, containing peroxide killer and acetic acid to neutralise any carry over alkalinity.

Dyeing:

Pad apply disperse and reactive dyes, together with all necessary chemicals, in the sequence:
Dry - thermofix - wash - dry - ready for chemical finish.
Cotton reactive dyes must be highly reactive and easily washed off; polyester disperse dyes must be alkaline resistant.

1) Pad apply dye/chemicals (55% nip expression) with a liquor containing:

Procion (RTM) Yellow MX-8G	0.95% calculated on total weight of fabric run (used for the cotton warp)
Dispersol (RTM) Blue XF	1.00% calculated on total weight of fabric run (used for the polyester weft)
Matexil (R.T.M.) FA-MIV	15 g/l
Lenetol WLF 125	1.5 g/l
Urea	50 g/l
Sodium bicarbonate	5 g/l
Sequestering agent - High temperature type	1 g/l (if necessary)

(Products supplied by ICI/Zeneca)

2) Infra-red pre-dry to prevent migration

3) Hot flue dry - 60 seconds at 110°C

4) Thermofix - 60 seconds at 210°C

5) Wash off sequence

Using a minimum of an 8 box wash unit

Bath 1 - soap boil) Zetex (R.T.M.) HP-LFN 0.5g/l

Bath 2 - soap boil) Caustic Soda 1.5g/l

Bath 3 - boiling water

Bath 4 - boiling water

Bath 5 - boiling water

Bath 6 - boiling water

Bath 7 - water at 70°C

Bath 8 - cold water rinse

6) Dry - hot cylinder dry onto A frames

Chemical Finish:

a) Pad apply (60% nip expression) at 20°C a liquor of pH 4 - 4.5 containing:

Acetic acid	2 ml/l
Knittex (R.T.M.) LE conc.	45 g/l
Knittex Catalyst MO	10 g/l
Oleophobol (R.T.M.) PF	25 g/l

b) Stenter dry - 2 chambers at 110° - 120°C

c) Stenter polymerise in 3 chambers at 180°C for 60 seconds

(Chemical products from Ciba)

Mechanical Finish:

Cold plain shell calender

The resultant cloth, with a yellow dyed cotton staple warp and a blue dyed polyester multifilament weft, is of an overall green colouration shot through with yellow and blue lights and exhibits distinct colour plays when turned through different viewing angles.

Example 2

Woven cotton/polyester microfibre fabric - single pass printing process

A greycloth fabric woven as described in Example 1 is printed and finished as follows:

Preparation:

1) Singe
2) Desize
3) Scour and peroxide bleach
4) Fully mercerise - 60° Tw caustic soda (33°Bé)
5) Stock paste preparation using sodium alginate thickener:

Manutex (R.T.M.) F 10% solution	500 parts
Matexil FA-N	5 parts
Urea	100 parts
Water to	1000 parts

6) Print paste formulation:

Stock paste	750 parts
Procion Yellow SP-SG (used for the cotton warp)	15 parts
Dispersol Blue R-PC liquid (used for the polyester weft)	16 parts
Water to	1000 parts

A sequestering agent (eg Lanapex HTS) may be added up to a maximum of 10% of the total weight of sodium alginate solid.

7) Print on a rotary or flatbed machine
8) High temperature steam fixation:
   eg Stork steamer (or equivalent) - 10 minutes at 175°C
9) Wash off sequence - multi-bath washer
   Bath 1 - cold water rinse/overflow
   Bath 2 - cold water rinse/overflow
   Bath 3 - set at pH12 with 2g/l caustic soda flake at the boil
   Bath 4 - set at pH12 with 2g/l caustic soda flake at the boil
   Bath 5 - set at pH12 with 2g/l caustic soda flake at the boil

Bath 6 - set at pH12 with 2g/l caustic soda flake at the boil

(Baths 3, 4, 5 and 6 - 3 minutes duration each)

Bath 7 - rinse at 70°C in water

Bath 8 - cold water rinse

10) Dry - hot cylinder dry onto A frames

11) Chemical finish: Pad apply, 60% nip expression at 20°C a liquor of pH 4 - 4.5 containing:

Acetic acid	2 ml/l
Knittex LE conc.	45 g/l
Knittex Catalyst MO	10 g/l
Oleophobol PF	25 g/l

12) Stenter dry - 2 chambers at 110° - 120°C

Stenter polymerise in 3 chambers at 180°C for 60 seconds

Mechanical Finish:

Cold plain shell calender

The dyes and chemicals used originate from Zeneca (ICI) and Ciba.

The printed cloth exhibits a similar appearance to the fabric produced in Example 1.

Example 3

Woven cotton/polyamide fabric, semi-continuous dyeing

A cloth is woven as follows:

Warp yarn:	100% American strict middling cotton fibre free of polypropylene contamination, average fibre length 1 1/16 inch (27 mm), combed ring spun, count 1/40s Ne_c (68s Nm).
Weft yarn:	100% type 66 polyamide multifilament microfibre, 70 denier (7.8 tex), 120 filaments (filament average 0.6 denier, 0.65 decitex).
Construction:	plain weave

Process water specification:

pH	7.0 ± 0.5
Copper:	0.05 mg/l max.
Iron:	0.05 mg/l max.
Chloride ions:	300 mg/l max.
Hardness:	Temporary carbonate - permitted
	Permanent = 20 parts per 100,000 water max.
	= 14° maximum average
Preferred water softening:	Ion exchange (removal of all ions except heavy metals) to zero + 5 deg. variation

Fabric preparation for colouring:

a) Singe - if required, on both sides

b) Desize - enzyme, stand for 10 hours, wash off

c) Scour and/or scour bleach according to colour shades to be applied:

A minimum of an 8 bath continuous range, to provide alkaline scour, washes, peroxide bleach, washes, followed by peroxide killer wash.

The cloth may require to be additionally causticized, using 12-15% caustic soda, or fully mercerised, using 28% caustic soda, to meet specific handle and lustre requirements.

After testing for starch removal and absorbency, the fabric is stored on A frames before proceeding with dyeing/printing.

Dyeing is performed sequentially on the warp and weft yarns, in a semi-continuous part batch process. The cotton warp is dyed first, as follows:

a) Pad apply (55% nip expression) the dye liquor containing high migration, high reactive type reactive dye (eg Procion MX), migration inhibitor, wetting agent, and sodium carbonate

b) Infra red pre-dry

c) Low temperature cylinder dry = 110°C maximum

d) Baking unit = 150°C for 60 seconds

e) Wash off multi box washer
- 40°C wash
- 2 x soap boil off
- 1 x 50°C wash off
- 1 x cold wash off
- 1 x acid rinse at 40°C with acetic acid

f) Cylinder dry onto A frames, 3000 yard batches

The polyamide weft is subsequently dyed as follows:

a) Pad apply (100% nip expression or as near as possible) a liquor containing acid or premetallised dyes, with wetting agent (eg Irgapadol (R.T.M.) PN - 10 g/l) at a pH of 6.0-6.5 (5.0-5.5 for heavy shades) using a buffer solution containing non-volatile acids, eg citric acid

b) High temperature steamer
15-20 minutes at 105°C - 107°C

c) Wash off - 4 x soap boil
- 2 x 50°C water

d) Cylinder dry - 2 x cold water

e) Stenter dry and set
5 chamber stenter, partially dry in chambers 1 and 2
Heat set 180°C for 25 seconds in chambers 3, 4, 5.

At this stage, finishing and stabilising agents can be pad applied, dried in the first two bays, then simultaneously set and polymerised in the last three bays. The polymerisation composition includes:

- Thermosetting resin - dimethyloldihydroxyethylene urea type (eg Fixapret (R.T.M.) CPNS)
- Acid catalyst
- Softener - usually cationic
- Fluorocarbon - for oil and body fat resistance
- Wetting agent

Mechanical Finishes:

Sanding, sueding, compacting, peaching, raising or cropping. These can be applied before or after chemical finishing, in any combination to obtain the end finish required.

Example 4

Woven cotton/polyester microfibre fabric - Overprinted delustre effect on dyed fabric

The dyed cloth produced as described in Example 1 is overprinted in selected areas with the silicic acid colloid type delustering agent Lurapret (R.T.M.) H in the water based liquor:

Binder TW (acrylic binder)	10 g/l
Binder TS (acrylic booster)	10 g/l
Lurapret H	5 g/l

All products are BASF chemicals.

After overprinting, the fabric is stenter dried or cylinder dried then stentered at 150°C for one minute.

These binders in combination give very good resistance to repeat washing and also to dry cleaning. The delustering agent reduces light reflection from the polyester fibres in the printed area, giving a subtle differential light effect between the overprinted polyester base fibres and those in the unprinted areas of the cloth.

Example 5

Woven cotton/polyester microfibre fabric - dye resist printed before overdyeing with colour tones

A greycloth constructed as described in Example 1, but before dyeing, is printed in selected areas with a dye resist, optionally containing a pigment, to partially block the subsequent dyeing of the whole fabric in those resist printed areas.

The process steps are:

1 Print the resist on to the fabric.
2 Dry/bake - cylinder/stenter, 150°C, 1 minute.
3 Dye the cotton/polyester microfibre blend with two dyes as described in Example 1.
4 Stenter dry.
5 Finish as required.

The formulation for printing the resist on to the greycloth is prepared from the following stock paste, in which all parts are by volume (ml), except white spirit/benzene, which is by weight (g):

	Parts
Water	32.5
Thickener solution	100
Matexil Emulsifier S	20
Matexil Binder AS	175
Matexil Fixer SE	15
Matexil Softener GK	7.5
White spirit or benzene	650
	1000

The printing paste is made up from the stock paste as follows:

	White	Coloured
Monaprint (RTM) E Pigment	-	x (as required)
Urea	10	10
Tartaric acid	50	50
Stock paste	850	850
Water	90	90-x
	1000	1000

The pigments and chemicals quoted are from Zeneca but equivalents can also be obtained from most international chemical companies.

In the subsequent dyeing stage, carried out as described in Example 1, the resist-printed areas resist both dyes. If the resist is a white paste, without pigment, the dyes give flat (dull) or pale shades; if the resist is pigmented, each dye shade is totally changed.

Example 6

Woven cotton/polyester microfibre fabric - Overprinted after dyeing

The dyed cotton and polyester microfibre cloth produced as described in Example 1 is overprinted with a paste that may optionally contain coloured pigments.

The stock paste formulation is as follows:

	Parts
Odourless kerosene	300
Water-in-oil emulsifier	50
Water	365
Alkali solution	75
Oil-in-water emulsifier	60
Polyacrylic acid	150
	1000

The printing paste is made up from the stock paste as follows:

	Parts
Stock paste	450
Surfactant	3
Binder	97
Pigment	as required
Water	as required
	1000

The printed cloth is cylinder dried and stentered for 1 minute at 150°C. If the printing paste contains no pigment, the finished cloth shows a variation in sheen between treated and untreated areas, which is different from the differential lustre obtained in Example 4.

If the printing paste does contain pigment, such as a standard metal based pigment (eg Helizarin (R.T.M.) - BASF), the printed area exhibits an overcolour which blocks out the underlying dyes.

Alternative dyeing routes for woven cotton/polyester microfibre cloth include the following sequences:

a) Pad, steam, pad, thermofix, pad, steam, wash, dry
b) Double bake, pad, thermofix, pad, steam, wash, dry
c) Double bake and reduction clear - as above (b) and extra pad, steam, wash, dry
d) Thermosol and pad batch
e) Several other variations of the above processes
f) Discontinuous batch dyeing

In the same way, other yarn fibre combinations can be woven and dyed in accordance with the invention. Using cotton as the preferred warp yarn, the following weft yarns may be employed; in all these combinations, reactive or vat dyes are suitable for the cotton yarn.

Weft	Dyestuffs
Polyamide	Acid dyes
	Premetallised dyes
	Disperse dyes
Polyacrylic	Modified basic dyes
	Disperse dyes
Wool	Acid levelling dyes
Silk	Premetallised dyes
	Acid dyes
	Acid levelling dyes
Polypropylene	Solution dyed

The embodiments described above provide a number of significant advantages. One of the principal benefits and advantages of the invention is that it provides a low cost mass production route to the bulk manufacture of wide width sheeting with colour effects that have heretofore only been possible by entirely uneconomic yarn dyeing methods. This look by any method has never been produced for sheeting before. Numerous fibre combinations and dye routes can be addressed by the invention, and especially fabrics in which the weft comprises solely multifilament microfibre yarn of 1 decitex or less while the warp comprises only cotton or other natural fibre in proportion to the bulk of the microfibre weft.

Dyeing both threads together, after the fabric has been constructed, with dyestuffs that are specifically matched to the properties of the different yarns, can produce a harmonious fabric of either iridescent colour or iridescent bloom, depending on the selection of colours. Furthermore, all the colour effects can be overprinted to enhance the final appearance. The resulting fabric can provide a luxurious and expensive look and feel. Accordingly, luxurious wide width sheeting for making furnishing fabrics, bed linen and table linen can be provided at a reasonable cost.

CLAIMS

1 A process for manufacturing a coloured woven fabric comprising:

(a) providing a first yarn and a second yarn, in which at least one of the first yarn and the second yarn is a multifilament yarn, and the first yarn is of a different composition to the second yarn;

(b) weaving a fabric of warp threads and weft threads from the first and second yarns, so that one of the said yarns provides the warp threads and the other of the said yarns provides the weft threads; and

(c) colouring the woven fabric by a method which is characterised by the application of at least two different dyestuffs, so that at least one of the said dyestuffs is preferentially taken up by the warp threads and at least one other of the said dyestuffs is preferentially taken up by the weft threads.

2 A process according to claim 1 wherein the warp threads and the weft threads become differently coloured and the woven fabric exhibits an iridescent play of colours to the eye upon inspection.

3 A process according to claim 1 or claim 2 wherein one of the first and second yarns is a spun fibre yarn.

4 A process according to claim 3 wherein the warp threads comprise a spun fibre yarn.

5 A process according to claim 3 or claim 4 wherein the spun fibre yarn comprises natural or modified natural fibres.

6 A process according to claim 3 or claim 4 wherein the spun fibre yarn comprises cotton, linen, flax, wool or regenerated cellulose.

7 A process according to any one of the preceding claims wherein the weft threads comprise a multifilament yarn.

8 A process according to any one of the preceding claims wherein the multifilament yarn comprises man made fibres or silk.

9 A process according to claim 8 wherein the multifilament yarn comprises polyester, polyamide, polyacrylic, polypropylene or regenerated cellulose filaments.

10 A process according to any one of the preceding claims wherein the multifilament yarn is a microfibre yarn made up of filaments having a linear density of one decitex or less.

11 A process according to any one of the preceding claims comprising weaving the fabric in a square weave with a number ratio of warp threads to weft threads from 45:55 to 55:45.

12 A process according to any one of the preceding claims which comprises weaving the fabric in a square weave with a weight ratio of warp threads to weft threads from 30:70 to 70:30.

13 A process according to any one of the preceding claims which comprises weaving the fabric from a warp which is a spun yarn of 100% cotton fibre and a weft which is a polyester microfibre multifilament yarn.

14 A process according to any one of claims 1 to 12 which comprises weaving the fabric from a warp which is a spun yarn of 100% cotton fibre and a weft which is a polyamide microfibre multifilament yarn.

15 A process according to claim 13 wherein the woven fabric is coloured by the simultaneous application of a reactive dye to colour the warp threads and a disperse dye to colour the weft threads.

16 A process according to claim 14 wherein the woven fabric is coloured by the sequential application of a reactive dye to colour the warp threads and an acid or premetallised dye to colour the weft threads.

17 A process according to any one of the preceding claims wherein the first yarn is of spun cotton fibre having a cotton count between 10s and 120s Nm.

18 A process according to claim 17 wherein the first yarn has a cotton count between 50s and 85s Nm.

19 A process for manufacturing a coloured woven fabric substantially as herein described with reference to any one of the specific examples.

20 A coloured fabric woven from a first yarn and a second yarn, in which at least one of the first yarn and the second yarn is a multifilament yarn, the first yarn is of a different composition to the second yarn, and one of the said yarns provides the warp threads and the other of the said yarns provides the weft threads of the woven fabric, and the fabric has been coloured after weaving by at least two different dyestuffs, at least one of the said dyestuffs having been preferentially taken up by the warp threads and at least one other of the said dyestuffs having been preferentially taken up by the weft threads.

21 A fabric according to claim 20 wherein the warp threads and the weft threads are differently coloured and the woven fabric exhibits an iridescent play of colours to the eye upon inspection.

22 A fabric according to claim 20 or claim 21 wherein one of the first and second yarns is a spun fibre yarn.

23 A fabric according to claim 22 wherein the warp threads comprise a spun fibre yarn.

24 A fabric according to claim 22 or claim 23 wherein the spun fibre yarn comprises natural or modified natural fibres.

25 A fabric according to claim 22 or claim 23 wherein the spun fibre yarn comprises cotton, linen, flax, wool or regenerated cellulose.

26 A fabric according to any one of claims 20 to 25 wherein the weft threads comprise a multifilament yarn.

27 A fabric according to any one of claims 20 to 26 wherein the multifilament yarn comprises man made fibres or silk.

28 A fabric according to claim 27 wherein the multifilament yarn comprises polyester, polyamide, polyacrylic, polypropylene or regenerated cellulose filaments.

29 A fabric according to any one of claims 20 to 28 wherein the multifilament yarn is a microfibre yarn made up of filaments having a linear density of one decitex or less.

30 A fabric according to any one of claims 20 to 29 which has a square weave with a number ratio of warp threads to weft threads from 45:55 to 55:45.

31 A fabric according to any one of claims 20 to 30 which has a square weave with a weight ratio of warp threads to weft threads from 30:70 to 70:30.

32 A fabric according to any one of claims 20 to 31 which comprises a warp which is a spun yarn of 100% cotton fibre and a weft which is a polyester microfibre multifilament yarn.

33 A fabric according to any one of claims 20 to 31 which comprises a warp which is a spun yarn of 100% cotton fibre and a weft which is a polyamide microfibre multifilament yarn.

34 A fabric according to any one of claims 20 to 31 wherein the warp threads comprise a spun cotton yarn, coloured after weaving by the application of a reactive or vat dyestuff.

35 A fabric according to claim 34 wherein the weft threads comprise a polyamide multifilament yarn which is coloured after weaving by an acid dye, a premetallised dye or a disperse dye.

36 A fabric according to claim 34 wherein the weft threads comprise a polyacrylic multifilament yarn which is coloured after weaving by a modified basic dye, or a disperse dye.

37 A fabric according to claim 34 wherein the weft threads comprise a silk multifilament yarn which is coloured after weaving by a premetallised dye, an acid dye or an acid levelling dye.

38 A fabric according to claim 34 wherein the weft threads comprise a polypropylene multifilament yarn which is coloured after weaving by a solution dye.

39 A fabric according to any one of claims 20 to 38 wherein the first yarn is of spun cotton fibre having a cotton count between 10s and 120s Nm.

40 A fabric according to claim 39 wherein the first yarn has a cotton count between 50s and 85s Nm.

41 A coloured woven fabric substantially as herein described with reference to any one of the specific examples.

The Patent Office

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Application No: GB 9505727.9
Claims searched: 1-41

Examiner: Alexander Littlejohn
Date of search: 19 June 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): D1K

Int Cl (Ed.6): D03D 15/00; D06P 3/82, 3/87, 3/872, 3/874

Other: Online: WPI, Claims

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB1059567	(Courtaulds) see whole document, e.g. page 1 lines 49-54 and page 2 lines 17-53	1-9,11,12, 20-28,30, 31,34-36
X	US4801303	(Carlough) see whole document, e.g. col. 1 lines 19-56	1-9,11,12, 20-28,30, 31,34-36
X	US4678473	(Vigo) see whole document, e.g. col.3 line 50 - col. 4 line 27	1-9,11,12, 20-28,30, 31,34-36
X	US4300902	(Connor) see whole document, e.g. col. 5 lines 27-37	1-9,11,12, 20-28,30, 31,34-36

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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